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NAVAL AIR TEST CENTER

REPORT OF TEST RESULTS

FROM

Commander, Naval Air Test Center, Patuxent River, Maryland 20670

TO

Commander, Naval Air Systems Command, Washington, D. C. 20361

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	First Interim	Normal

TITLE

Technical Evaluation of the AV-8B/F402 Engine Trim Test Set

DATES OF TESTS	LOCATION OF TESTS	COGNIZANT NAVAIRSYSCOM DIVISION
10 through 14 March 1980	NAVAIRTESTCEN	AIR-512
NATC PROJECT OFFICER/ENGINEER	NATC DIVISION	COGNIZANT NAVAIRSYSCOM ENGINEER
Mr. T. Bowles	Systems Engineering	Mr. B. Berisford

INTRODUCTION

1. The AIRTASK/Work Unit tasked the Naval Air Test Center to perform a Technical Evaluation (TECHEVAL) of the AV-8B/F402 Engine Trim Test Set to determine its suitability and supportability when used to trim the F402 engine in a shipboard environment. This report contains the results of testing from 10 through 14 March 1980 which consisted of initial inspection, operational checks, aircraft compatibility tests, and Electromagnetic Susceptibility (EMS) tests.

2. The H249 Engine Trim Test Set is designed to be capable of accurately measuring and displaying low and high pressure tachometer signals, Jet Pipe Temperature (JPT), various engine acceleration times, maximum low pressure compressor speed, and JPT peaks. The test set also features a free-run time position, temperature simulation for static checkout of the JPT indicator, JPT limiter, an engine life recorder, and indicates water injection RPM droop. The test set is 20 in. long by 18 in. wide by 12 in. deep, and weighs 43 lb of which 19 lb is the electronic package.

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Part I indicates a deficiency, the correction of which is necessary because it adversely affects:

- a. Airworthiness of the aircraft.
- b. The ability of the aircraft (or piece of equipment) to accomplish its primary or secondary mission (or intended use).
- c. The effectiveness of the crew as an essential subsystem.
- d. The safety of the crew or the integrity of an essential subsystem. In this regard, a real likelihood of injury or damage must exist. Remote possibilities or unlikely sequences of events shall not be used as a basis for safety items.

Part II indicates a deficiency of lesser severity than a Part I which does not substantially reduce the ability of the aircraft or piece of equipment to accomplish its primary or secondary mission, but the correction of which will result in significant improvement in the effectiveness, reliability, maintainability, or safety of the aircraft or equipment. A Part II deficiency is a deficiency which either degrades the capabilities of the aircraft or equipment or requires significant operator compensation to achieve the desired level of performance; however, the aircraft or equipment being tested is still capable of accomplishing its mission with a satisfactory degree of safety and effectiveness.

Part III indicates a deficiency which is minor or slightly unpleasant or appears too impractical or uneconomical to correct in this model, but should be avoided in future designs.

RESULTS AND REMARKS

GENERAL

3. The H249 Engine Trim Test Set was used to perform shore based trimming of an F402 engine at the organizational level of maintenance. One Part I deficiency made it unsuitable for use on a flight deck. After correction of this Part I deficiency and three Part II deficiencies, and a successful retest, it is recommended that the H249 Engine Trim Test Set be procured as interim trim equipment for the AV-8 aircraft.

SPECIFIC

4. Initial inspection of the H249 disclosed paint and nonconductive adhesive between the instrument panel Electromagnetic Interference (EMI) gasket and case. In addition, the cable shields were not terminated peripherally in the connectors. These items were corrected prior to commencement of EMS tests. However, approved EMI connectors will be required to be installed as soon as they are available to the manufacturer.

5. No problems were detected during EMS tests in the high frequency A, B, and D band testing. However, the testing did reveal that the H249 was susceptible to EMI when exposed to high levels of E, G, and I band radars at thresholds of susceptibility of approximately $2 \text{ MW}/\text{CM}^2$, $1 \text{ MW}/\text{CM}^2$, and $4.5 \text{ MW}/\text{CM}^2$, respectively. All testing was accomplished in accordance with MIL-HDBK-235-2 (Navy) Table V which defines the electromagnetic environment which must be utilized in EMS testing to duplicate conditions present in a shipboard environment. Although these high levels of E, G, and I band radar emissions are seldom actually encountered on a flight deck, the EMS exhibited is a Part I deficiency which should be corrected prior to fleet delivery.

6. Points of entry for this EMI were identified and could be eliminated by the following corrective measures:

- a. Improved shielding of the digital display units.
- b. Increased area of clean metal-to-metal contact of the panel-to-case interface.
- c. Peripheral termination of the cable shields.

A retest of these problem areas will be conducted after corrective measures are taken by the contractor.

7. The following Part II deficiencies were found during the TECHEVAL which should be corrected as soon as practicable and preferably prior to fleet delivery:

- a. Lack of operation, repair, and calibration procedures.

- b. Inadequate length of power cable. The power cable provided for the TECHEVAL had a length of 50 ft, as was specified by the Navy to the contractor. Successful operation was possible with the cable. This length of the cable was originally established to enable the trim set operator to be at the same distance from the aircraft as permitted of the ground crew utilizing the 50 ft Internal Communication System (ICS) set cable. However, the ICS Cable attaches to the aircraft near the engine inlets. The trim set power cable attaches aft of the engine exhaust nozzles and it must then be routed to forward of the engine inlets before it can be routed away from the aircraft. If it is not routed and secured forward, along the fuselage of the aircraft, it will be damaged by the jet blast from the exhaust nozzles. The routing of the power cable utilizes 16 ft of the cable. This results in the trim set operator being 16 ft closer to the engine inlets, which lack any foreign object damage or anti-personnel screens during trim runs, thus decreasing the margin of safety under which he operates. It is recommended that a 66 ft cable be provided with the trim set.
- c. Inadequate length of pigtail on temperature cable. The termination of the cable insulation needs to be 22 in. from the cable end vice 16 in. to facilitate the utilization of the drain hole (panel 37R) as a feed-thru for the temperature cable during engine trim. Operation was possible with a 16 in. pigtail but was difficult to accomplish.

8. Although the test set was considered to be excessive in size (20 in. long by 18 in. wide by 12 in. deep), its volume is comparable to similar test sets which conform to the design objectives of the F402 Engine Trim Test Set set forth by the Naval Air Engineering Center Design Data Package 92-166. The simplicity in design of the H249 will enable the manufacturer to reduce the size significantly if requested, but will eliminate the desirable capability of stacking the cases for storage due to the size of the cable case. Military specifications relating to the design and construction of engine trim equipment should be reviewed to implement state-of-the-art packaging of electronic components. The apparent lack of direction to the manufacturer on design criteria for the trim set not only affected the miniaturization of the trim equipment, but delayed the entire AV-8 engine trim program.

CONCLUSIONS

9. The H249 Engine Trim Test Set was used successfully to perform shorebased trimming of an F402 engine but incorporated one Part I deficiency that made it unsuitable for use on a flight deck.

PART I DEFICIENCY

10. Electromagnetic susceptibility in radar bands E, G, and I (paragraph 5).

PART II DEFICIENCIES

11. Lack of operation, calibration, and repair manuals (paragraph 7.a).

12. Inadequate length of power cable (paragraph 7.b).

13. Inadequate length of temperature cable pigtail (paragraph 7.c).

RECOMMENDATIONS

14. After correction of deficiencies and successful retest, procure the H249 Engine Trim Test Set as interim trim equipment for AV-8 aircraft.

15. Correct the Part I deficiency cited in paragraph 10 prior to delivery to the fleet.

16. Correct the Part II deficiencies cited in paragraphs 11, 12, and 13 as soon as practicable and preferably prior to fleet delivery.

17. Review all military specifications relating to the design and construction of engine trim equipment to implement state-of-the-art packaging of electronic components (paragraph 8).


R. W. BRECKON
By direction

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